

The HCN World: Establishing Protein-Nucleic Acid Life

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Hydrogen cyanide polymers—heterogeneous solids varying in color from yellow to orange to brown to black—could be major components of the dark matter observed on many bodies in the outer solar system, including asteroids, comets, moons, rings and planets. Returned sample missions now in progress (such as project Stardust) may well show the presence of cyanide polymers and their products in cometary and other extraterrestrial material. Current studies of these ubiquitous compounds point to the presence of polyamidines which are converted directly by water to polypeptides, without the intervening formation of α - amino acids. Additionally, pyrolysis of the intermediate polymers gives rise to nitrogen heterocycles with purine and pyrimidine structures.

Implications for prebiotic chemistry are profound. Primitive Earth may have been covered by HCN polymers as well as other organic compounds through bolide bombardment or by photochemical reactions in a reducing atmosphere. Most significant would have been the parallel synthesis of polyamidines on sugars, phosphates and nitrogen bases.

On our dynamic planet this polypeptide-polynucleotide symbiosis mediated by polyamidines could have set the pattern for the evolution of protein-nucleic acid systems controlled by enzymes, the mode characteristic of life on Earth today. Life on other planets around other stars would similarly be expected to be based on polypeptides and polynucleotides arising from this preferred pathway via HCN.